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ORIGINAL COMMUNICATION

Fluoroscopic placement of nasojejunal feeding tubes in COVID-19 patients in the prone position

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Abstract

Background: Coronavirus disease 2019 (COVID-19) has caused an increase in patients requiring enteral feeding access while undergoing proning for severe acute respiratory distress syndrome (ARDS). We investigated the safety and feasibility of fluoroscopy-guided nasojejunal (NJ) feeding tube placement in the prone position.

Methods: This is a retrospective cohort study of all patients who underwent fluoroscopic placement of NJ feeding tubes at a single institution between March 2020 and December 2020. Primary end points were success rate and number of attempts. Chi-squared and Fischer exact tests were used to compare prone and supine groups.

Results: A total of 210 patients were included in the study: 53 patients received NJ feeding tubes while prone and 157 while supine. All but one patient in the prone group had ARDS secondary to COVID-19, whereas 47 (30.3%) had COVID-19 in the supine group. The rate of successful placement was 94.3% in the prone group and 100% in the supine group. Mean number of attempts was 1.1 (SD, ±0.4) in the prone and 1.0 (SD, ±0.1) in the supine group ($P = .14$). Prone patients had a longer median fluoroscopy time (69 s, interquartile range [IQR] = 92; vs 48 s, IQR = 43; $P < .001$) and received a higher radiation dose during the procedure (47 mGy, IQR = 50; vs 25 mGy, IQR = 33; $P = .004$). No procedural complications were reported.

Conclusion: Fluoroscopy-guided NJ feeding tube placement in prone patients is feasible and safe. Patient positioning should not delay obtaining postpyloric feeding access.

KEYWORDS
adult, critical care, enteral access, GI access

Clinical Relevancy Statement

We found fluoroscopy-guided nasojejunal feeding tube placement in patients in the prone position to be safe with a high success rate and number of attempts similar to those who were supine. This has clinical implications when considering whether to delay nasojejunal feeding tube placement because of patient positioning.

BACKGROUND

The advent of coronavirus disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2, placed enormous stress on intensive care units (ICUs) in the United States and around the world. Of all hospitalized patients, ~10%–20% have required ICU services because of respiratory failure and acute respiratory distress

syndrome (ARDS).[1] Initiating nutrition early in critically ill patients has been found to be beneficial in reducing septic complications, shortening ICU length of stay, and decreasing mortality.[2–4] Current guidelines by the American Society for Parenteral and Enteral Nutrition (ASPEN) recommend that enteral nutrition be initiated within 24–48 h in patients unable to maintain volitional intake.[5] Post-pyloric feeds via nasojejunal (NJ) feeding tube is preferred route of nutrition in critically ill patients who display intolerance or contraindication to gastric feeding. At our institution, it has been the feeding tube of choice to avoid potential intolerance to gastric feeds and the aspiration risk that some have found to be exacerbated by placing patients in the prone position, although not all reports agree.[6,7]

Intermittent prone positioning has been found to increase alveolar recruitment in COVID-19 patients with ARDS.[8] Although proning protocols for ARDS no doubt vary between institutions, the survival benefit of prone positioning, as described in the landmark paper by Guerin et al in 2013, required at least 16 h of prone positioning per day.[9] With recent increased numbers of patients experiencing ARDS caused by COVID-19, the volume of patients being proned as part of ARDS treatment has increased.[10] This poses a problem, as feeding tube placements are performed with the patient in a supine position, like most other bedside procedures. Delaying feeding tube placement to fit the positioning schedule of critically ill patients has the potential to cause a delay in the initiation of nutrition support. Instead of delaying feeding tube placement until patients were able to be shifted into the supine position, our institution's nutrition support team performed placement of fluoroscopy-guided NJ feeding tubes in the prone position. No published data exist that describe NJ feeding tube placement in the prone position, although nasogastric tube placement in non–critically ill prone patients has been described as feasible in the operating room setting.[11] This single-institution series is meant to shed light on this novel approach to NJ feeding tube placement, describing technique along with safety and feasibility, as determined by the rate of procedural complications and successful placement. We hypothesized that placement of fluoroscopically guided NJ feeding tubes in prone patients carried a similar success rate as supine placement.

METHODS

This study was conducted with approval from our Institutional Review Board with a waiver of informed consent. This is a retrospective cohort study, meant to both describe the technique of fluoroscopic NJ feeding tube placement in the prone patient and examine its feasibility and safety. Feasibility was defined as a success rate and a number of attempts similar to the standard approach of fluoroscopy-guided NJ tube placement in the supine position. Safety was defined as a similar rate of procedural complications for those receiving their tube prone and supine. This included epistaxis, tube misplacement, vomiting, or other adverse events directly related to tube placement. All adult patients requiring short-term enteral feeding access via NJ feeding tubes between April 1, 2020, and December 5, 2020, were included in the study. The need for an NJ feeding tube was determined as per clinician preference. All patients received their feeding tube with fluoroscopy guidance. Patients were chosen for either supine or prone placement based on their position during the time of nutrition consultation to minimize delay to the start of enteral nutrition. In all cases, a 140 cm, 8F nonweighted Corflo enteral feeding tube (Corpak Medsystems) with a wire stylet was used and placed at the bedside in the ICU by two of the authors (J.V. and J.D.P.). Successful placement was defined as confirmed tip of tube in the distal duodenum/jejunum, as verified with Gastrografin infusion on fluoroscopy, with the patient in the originally selected position. Number of attempts was defined by any repeat occasions required to place the tube with the tip in the postpyloric position.

Data gathered included demographic, hospital, and procedural data. Hospital data included the primary *International Statistical Classification of Diseases, Tenth Revision* diagnosis at the time of ICU admission, COVID-19 diagnosis, and invasive ventilation. Primary end points were the success rate and the number of attempts. Secondary end points included fluoroscopic time, radiation dose administered (mGy), and any procedural complications. Data were collected and stored in a secure REDCap database.[12] Quantitative, normally distributed data (age, body mass index, and number of attempts) are expressed as the mean ± SD, whereas nonnormally distributed data (fluoroscopic time and radiation dose) are expressed as the median and the interquartile range (IQR). Normality was determined through a review of the probability-probability plots. Nominal data are expressed as a percentage. Comparisons between groups for normally distributed, quantitative data were performed using the two-tailed, two-sample *t*-test, whereas comparisons between groups for nonnormally distributed, quantitative data were performed using the Mann-Whitney *U* test. Nominal variables were evaluated using the chi-squared or Fisher exact tests, as appropriate. Significance was assessed at $P < .05$. Statistical analysis was performed using Stata (Corpak Medsystems, IL, USA), version 16.1 (StataCorp, College Station, TX, USA).

Feeding tube placement technique

Fluoroscopy-guided NJ feeding tube placement in the supine position has been described before.[13] For prone patients, a portable C-arm fluoroscope was positioned over the patient's midthoracolumbar area, with the monitor flipped left-to-right to assist with corporeal orientation. A feeding tube was inserted through the superior nare and advanced to 55 cm, intermittently confirming correct position with fluoroscopy. Once the tube tip was intragastric, the wire stylet was removed to allow formation of a 45°-angled kink at the bottom 3 cm of the stylet (formation of a "hockey stick") before replacing the stylet into the feeding tube, to form a type of augur. Using the feeding tube, the stomach was insufflated, if/as necessary, with air to facilitate feeding tube passage to the pylorus. Once tip location was confirmed at the pylorus using fluoroscopy, the stomach was desufflated, if possible, and the tube maneuvered into the duodenum using a series of twisting (auguring) motions. This was done with the occasional injection of water-soluble contrast (Gastrografin) to better delineate gastric/duodenal anatomy.

TABLE 1 Demographics and intensive care unit admission diagnoses in the supine and prone groups

Variable	Supine (n = 157)	Prone (n = 53)	*P*
Age, mean ± SD, years	57.0 ± 15.9	60.9 ± 13.1	>.5
Male sex, n (%)	98 (62.4)	36 (67.9)	>.5
BMI, mean ± SD	32.6 ± 7.9	32.9 ± 6.35	>.5
White, n (%)	114 (72.6)	33 (62.3)	>.5

Abbreviation: BMI, body mass index.

TABLE 2 Primary disease diagnosis at time of intensive care unit admission in the supine and prone groups

Diagnosis	Supine (n = 157), n (%)	Prone (n = 53), n (%)
Acute respiratory failure	100 (63.7)	52 (98.1)
-Caused by COVID-19	47 (47.0)	52 (100.0)
Shock	35 (22.3)	0
-Cardiogenic shock	24 (68.6)	0
-Hypovolemic shock	8 (22.9)	0
-Shock, other	3 (8.6)	0
Traumatic brain injury	7 (4.5)	0
Stroke	5 (3.2)	0
Encephalopathy	3 (1.9)	0
STEMI	2 (1.3)	0
Cardiac arrest	2(1.3)	1 (1.9)
Other	3 (1.9)	0

Abbreviation: COVID-19, coronavirus disease 2019; STEMI, ST-segment elevation myocardial infarction.

Once the tip of the feeding tube was confirmed to be past the pylorus, the tube was advanced until the tip was located approximately at or distal to the ligament of Treitz, confirmed by injecting 10–15 ml of Gastrografin under fluoroscopy both to delineate anatomy and to assess bowel diameter and motility. A final fluoroscopic print confirming successful placement was saved.

RESULTS

The study included 210 patients, 53 of whom received their feeding tube while prone and 157 while supine. The mean age was 58 (SD, ± 15.3) years and 134 (63.4%) patients were male. The prone and supine groups were similar in terms of demographics ($P > .5$; Table 1). The most common primary diagnosis on admission to the ICU was acute respiratory failure; other common diagnoses in the supine group were cardiogenic shock and traumatic brain injury (Table 2). COVID-19 was the cause for respiratory failure in 52 of 53 patients in the prone group and 47 (29.9%) patients in the supine group. All prone patients (n = 53) and all but three supine patients (n = 154) were intubated and mechanically ventilated at the time of feeding tube placement.

Successful placement

The success rate of supine placement was higher in supine patients compared with prone patients: 100% (157 of 157) vs 94.3% (50 of 53), respectively ($P = .015$). The number of attempts before successful placement was similar between the groups, with a mean of 1.0 (SD, ± 0.1) in the supine group and 1.1 (SD, ± 0.4) in the prone group ($P = .14$).

Procedural outcomes

Fluoroscopy time in seconds, necessary to guide placement, was higher in the prone group with a median of 69 s (IQR = 92) for prone patients and 48 s (IQR = 43) for supine patients ($P < .001$). The median radiation dose administered was also higher for the prone group at 47 mGy (IQR = 50) compared with 25 mGy (IQR = 43) for supine patients ($P = .004$).

No adverse events from feeding tube placement occurred in either group.

DISCUSSION

This study aimed to determine the feasibility of placing NJ feeding tubes under fluoroscopy in patients while prone. Our results indicate a high rate of successful placement (94.3%), close to the observed 100% rate in supine patients, and the average number of attempts is similar to those observed with supine patients. The reported rate of successful nasoenteral placement in the literature has varied depending on method, but it generally remains between 80% and 96%.[14] Specifically for fluoroscopy-guided postpyloric placement, the success rate has been described as between 84% and 96%, which is well within the range of success described herein.[13,15,16] Therefore, although prone NJ tube placement carried a slightly worse success rate compared with supine, we still consider it a highly feasible approach to NJ tube placement. A potential barrier to the fluoroscopic placement of feeding tubes in COVID-19 patients at some institutions is the fact that patients need to be transferred to radiology for the procedure, which is not recommended if avoidable.[17] Good access to mobile bedside fluoroscopy equipment is therefore necessary for timely placement. Another recently described option for postpyloric feeding tube placement in COVID-19 patients is blind placement. This approach has been studied in small cohorts of critically ill patients, including those with COVID-19.[18–20] However, the technique of blind postpyloric feeding tube placement in COVID-19 patients described by Yuan et al involves shifting the patient into a right decubitus position with a head of bed elevation to 30° for pyloric intubation.[20] The technique is thus not applicable in patients while prone. Furthermore, reported success rates for blind postpyloric feeding tube placement have been in the range of 60% to 86%, far inferior to what is described here.[15,19,21]

We report fluoroscopy time as an indicator for procedure time instead of actual procedure time, as procedure times for bedside procedures are not routinely logged at our institution. However,

fluoroscopy time serves the purpose of comparing procedural times in this context given that this is a comparison between two fluoroscopy-guided approaches. Although the fluoroscopy time in prone patients was 30% longer compared with supine patients (69 s vs 48 s), this difference does not necessarily apply to other portions of the procedure, such as the setup and tube advancement while not under fluoroscopy, which is likely independent of patient position. We believe that the difference in total procedure time is less pronounced overall, although that remains to be seen. Whereas most investigators have been able to report actual procedure times, which have ranged from 15 to 30 min,[14,16,22] Ott et al were able to report fluoroscopy time.[22] In 94 successful placements, they described a mean fluoroscopy time of 8.6 min, considerably longer than the 69 s we report in our prone group. One possible explanation for this observed difference in fluoroscopy time is that the fluoroscopists in their study were largely radiology trainees and, therefore, assumably early in their learning curve. Additionally, less experience with fluoroscopy-guided NJ feeding tube placement had accumulated when their study was performed 30 years ago. As our results demonstrate, in the hands of experienced clinicians, the minor technical tweaks required for prone placement are not a considerable hindrance to near optimal efficiency. Radiation dose differed slightly between groups (median 47 mGy for prone vs 25 mGy for supine), another indication of the modestly increased effort required for placement in the prone position. Neither group approached radiation doses utilized in many other elective fluoroscopy procedures and certainly remained far from peak skin doses associated with toxic effects.[23]

We had no procedural adverse events related to feeding tube placement in our cohort. Procedural adverse events are generally reported around 3%, although there has been some heterogeneity as to the definition of such events, contributing to reports up to 20%.[14,19] The most commonly reported adverse events following fluoroscopic placement include epistaxis, vomiting, and hypotension.[14,24]

This study has limitations. Aside from its retrospective nature, we do not know the actual time prone feeding tube placement saved in terms of starting enteral nutrition. For this to be measured, patients undergoing prone positioning would have to be randomized into supine and prone placement of nasoenteric feeding tube. Such data could further elucidate the benefit of prone placement in terms of time to initiation of feeds. Secondly, this study does not consider other methods of postpyloric tube placement, such as electromagnetic or endoscopic guidance, which some institutions might prefer over fluoroscopy. Finally, a power analysis was not run prior to conducting this study. However, the primary outcome variable was successful placement in the prone position vs the supine position, which showed a statistically significant difference, indicating sufficient power for the analysis. That having been said, the high success rate in the prone group (94.3%) is nevertheless a strong argument for its use in the clinical setting.

The data herein show that this novel approach to feeding tube placement is a feasible approach in patients requiring postpyloric enteral access because of COVID-19. This is important given the recent high number of patients with ARDS caused by COVID-19 requiring prone positioning. In conclusion, fluoroscopic placement of NJ feeding tubes in patients while in the prone position carries an excellent success rate and is safe. Prone position should not be considered a reason to delay obtaining postpyloric feeding access.

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AUTHOR CONTRIBUTIONS

Hordur Mar Kolbeinsson, James Veldkamp, and James D. Paauw equally contributed to the conception and design of the study. Hordur Mar Kolbeinsson contributed to the acquisition of data and drafted the manuscript. James Veldkamp and James D. Paauw critically revised the manuscript. All three authors gave final approval and agree to be accountable to all aspects of the work.

CONFLICT OF INTEREST

None declared.

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